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PLANETARY PHENOMENA FOR NOVEMBER AND DECEMBER, 1896.

By PROFESSOR MALCOLM MCNEILL.

NOVEMBER, 1896.

Mercury is a morning star at the beginning of the month, having passed greatest western elongation on October 24th. For the first week of November it rises an hour or more before sunrise, and there is a fair chance for visibility under favorable atmospheric conditions. After that it rapidly approaches the Sun and comes to superior conjunction on the afternoon of November 28th.

Venus is evening star, and throughout the month sets from an hour and a half to two hours and a half after sunset. It is moving very rapidly eastward among the stars, forty degrees during the month, from a position near the red star *Antares* in *Scorpio*, through that constellation and *Sagittarius*, nearly to the west boundary of *Capricornus*.

Mars is coming near to opposition and is quite a conspicuous object in the sky. By the end of the month it rises very soon after sunset. It is on the borders of the constellations *Taurus* and *Gemini*, and after November 1st it retrogrades, moving westward about nine degrees during the month. During the month its distance from us in millions of miles lessens from sixty-one to about fifty-two.

Jupiter is in better position for observation, rising before midnight at the end of the month. During the month it moves about three degrees eastward and southward in the constellation

Leo, and at the beginning of the month it is about eight degrees from the first magnitude star *Regulus*. It is in quadrature with the Sun on November 30th.

Saturn is too near the Sun for observation during the month. It passes conjunction and changes from an evening to a morning star on the morning of November 13th. By the end of the month it rises more than an hour before the Sun, but its dull color and lack of brightness will make it a hard object to see without the telescope.

Uranus is near *Saturn* and passes conjunction with the Sun only three days later, on November 16th. So it is also in bad position for naked eye visibility.

Neptune is in the constellation *Taurus*, a few degrees to the west of *Mars*.

DECEMBER.

The Earth is in perihelion at about 4 A.M., December 31st, P. S. T.

Mercury is an evening star and towards the end of the month is nearly out to greatest eastern elongation. For the last ten days of the month it remains above the horizon about an hour after sunset, and it may be seen if the sky is clear.

Venus is also an evening star, and is getting well out toward greatest elongation. By the end of the month it sets nearly three hours and one-half after sunset. It moves eastward and northward during the month nearly forty degrees, from the eastern part of *Sagittarius* through *Capricornus*.

Mars is in the best position for observation since October, 1894. It comes to opposition with the Sun on December 10th, 9 P.M., P. S. T., and is above the horizon practically throughout the whole night. It moves westward about eleven degrees during the month in the eastern part of the constellation *Taurus*, and at the end of the month is not far from the first magnitude red star *Aldebaran*. On the night of December 18th it passes about one degree south of the Moon. At opposition its distance from us in millions of miles is about fifty-two and one-half. The nearest approach to the Earth occurs about a week earlier, and the planet is then about half a million miles nearer to us. The planet passed its perihelion in June, six months before coming to opposition, and its distance at opposition is therefore much greater than it was during the last two oppositions which occurred much nearer the times of perihelion passage. In October, 1894, the least distance was 40,000,000 miles, and in August, 1892, it was only 35,000,000. The great northern declination of *Mars* makes the present opposition not a bad one for observations in the Northern Hemisphere, since the meridian altitude of the planet is seventeen degrees greater than it was at the opposition of 1894, and forty-nine degrees greater than at the opposition of 1892; the great increase in altitude almost, if not quite, counterbalances the loss of light from increased distance.

By the end of the month *Jupiter* rises at about half-past nine. It is in the constellation *Leo*, and moves about one degree eastward before December 25th. It then turns and begins to move westward.

Saturn is a morning star, and by the end of the month rises more than three hours before the Sun. It moves about three degrees eastward in the constellation *Libra.* The rings are slightly wider open than they were before conjunction.

Uranus is very near *Saturn* and is also moving eastward. The two planets are in conjunction on the morning of December 28th, when *Uranus* is not quite two degrees south of *Saturn.*

Neptune is near *Mars*, and is in conjunction with it early in the month. It is in opposition with the Sun on the morning of December 10th.

EXPLANATION OF THE TABLES.

The phases of the Moon are given in Pacific Standard time. In the tables for Sun and planets, the second and third columns give the Right Ascension and Declination for Greenwich noon. The fifth column gives the local mean time for transit over the Greenwich meridian. To find the local mean time of transit for any other meridian, the time given in the table must be corrected by adding or subtracting the change per day, multiplied by the fraction whose numerator is the longitude from Greenwich in hours, and whose denominator is 24. This correction is seldom much more than 1^m. To find the standard time for the phenomenon, correct the local mean time by *adding* the difference between standard and local time if the place is west of the standard meridian, and *subtracting* if east. The same rules apply to the fourth and sixth columns, which give the local mean times of rising and setting for the meridian of Greenwich. They are roughly computed for Lat. 40°, with the noon Declination and time of meridian transit, and are intended as only a rough guide. They may be in error by a minute or two for the given latitude, and for latitudes differing much from 40° they may be several minutes out.

PHASES OF THE MOON, P. S. T.

		H. M.
New Moon,	Nov. 4,	11 27 P. M.
First Quarter,	Nov. 11,	9 41 P. M.
Full Moon,	Nov. 20,	2 25 A. M.
Last Quarter,	Nov. 27,	6 44 P. M.

THE SUN.

1896.	R. A. H. M.	Declination. ° ′	Rises. H. M.	Transits. H. M.	Sets. H. M.
Nov. 1.	14 29	− 14 42	6 35 A.M.	11 44 A.M.	4 53 P.M.
11.	15 9	− 17 39	6 45	11 44	4 43
21.	15 50	− 20 6	6 57	11 46	4 35
Dec. 1.	16 33	− 21 57	7 8	11 49	4 30

MERCURY.

Nov. 1.	13 31	− 7 21	5 11 A.M.	10 46 A.M.	4 21 P.M.
11.	14 30	− 13 36	5 52	11 6	4 20
21.	15 33	− 19 9	6 36	11 29	4 22
Dec. 1.	16 39	− 23 11	7 19	11 55	4 31

VENUS.

Nov. 1.	16 31	− 22 57	9 9 A.M.	1 46 P.M.	6 23 P.M.
11.	17 24	− 24 40	9 31	2 0	6 29
21.	18 18	− 25 11	9 47	2 14	6 41
Dec. 1.	19 12	− 24 27	9 58	2 28	6 58

MARS.

Nov. 1.	5 57	+ 24 13	7 45 P.M.	3 14 A.M.	10 43 A.M.
11.	5 55	+ 24 41	7 1	2 32	10 3
21.	5 46	+ 25 9	6 11	1 44	9 17
Dec. 1.	5 31	+ 25 31	5 15	12 50	8 25

Jupiter.

1896.	R. A.	Declination.	Rises.	Transits.	Sets.
	H. M.	° ′	H. M.	H. M.	H. M.
Nov. 1.	10 32	+ 10 10	1 18 A.M.	7 48 A.M.	2 22 P.M.
11.	10 37	+ 9 42	12 41	7 14	1 47
21.	10 42	+ 9 19	12 7	6 39	1 11
Dec. 1.	10 45	+ 9 1	11 32 P.M.	6 3	12 34

Saturn.

Nov. 1.	15 14	− 15 55	7 24 A.M.	12 28 P.M.	5 32 P.M.
11.	15 18	− 16 14	6 51	11 54 A.M.	4 57
21.	15 23	− 16 32	6 17	11 19	4 21
Dec. 1.	15 28	− 16 50	5 44	10 45	3 46

Uranus.

Nov. 1.	15 26	− 18 31	7 46 A.M.	12 41 P.M.	5 36 P.M.
11.	15 29	− 18 40	7 10	12 4	4 58
21.	15 31	− 18 49	6 33	11 27 A.M.	4 21
Dec. 1.	15 34	− 18 58	5 57	10 50	3 43

Neptune.

Nov. 1.	5 16	+ 21 38	7 16 P.M.	2 33 A.M.	9 50 A.M.
11.	5 15	+ 21 37	6 36	1 53	9 10
21.	5 14	+ 21 36	5 55	1 12	8 29
Dec. 1.	5 14	+ 21 34	5 15	12 32	7 49

ECLIPSES OF *JUPITER'S* SATELLITES, P. S. T.

(Off left-hand limb, as seen in an inverting telescope.)

		H. M.			H. M.
III, R,	Nov. 3.	1 41 P. M.	III, D,	Nov. 18.	3 36 A. M.
II, D,	6.	12 23 A. M.	III, R,	18.	7 7 A. M.
I, D,	6.	5 38 A. M.	II, D,	20.	5 34 A. M.
I, D,	8.	12 7 A. M.	I, D,	22.	3 53 A. M.
III, D,	10.	11 38 P. M.	I, D,	23.	10 21 P. M.
III, R,	11.	3 9 A. M.	I, D,	29.	5 46 A. M.
II, D,	13.	4 59 A. M.	II, D,	30.	9 29 P. M.
I, D,	15.	2 0 A. M.	I, D,	31.	12 14 A. M.

PHASES OF THE MOON, P. S. T.

		H. M.
New Moon,	Dec. 4,	9 51 A. M.
First Quarter,	Dec. 11,	4 29 P. M.
Full Moon,	Dec. 19,	8 5 P. M.
Last Quarter,	Dec. 27,	4 9 A. M.

THE SUN.

1896.	R. A. H. M.	Declination. ° ′	Rises. H. M.	Transits. H. M.	Sets. H. M.
Dec. 1.	16 33	− 21 57	7 8 A.M.	11 49 A.M.	4 30 P.M.
11.	17 17	− 23 5	7 17	11 54	4 31
21.	18 1	− 23 27	7 24	11 59	4 34
31.	18 45	− 23 3	7 27	12 4 P.M.	4 41

MERCURY.

Dec. 1.	16 39	− 23 11	7 19 A.M.	11 55 A. M.	4 31 P.M.
11.	17 47	− 25 17	7 57	12 24 P.M.	4 51
21.	18 57	− 25 2	8 27	12 55	5 23
31.	20 2	− 22 17	8 41	1 21	6 1

VENUS.

Dec. 1.	19 12	− 24 27	9 58 A.M.	2 28 P.M.	6 58 P.M.
11.	20 4	− 22 32	10 2	2 41	7 20
21.	20 54	− 19 34	10 1	2 52	7 43
31.	21 41	− 15 45	9 55	3 0	8 5

MARS.

Dec. 1.	5 31	+ 25 31	5 15 P.M.	12 50 A.M.	8 25 A.M.
11.	5 14	+ 25 40	4 12	11 48 P.M.	7 24
21.	4 58	+ 25 35	3 18	10 53	6 28
31.	4 46	+ 25 24	2 28	10 2	5 36

JUPITER.

Dec. 1.	10 45	+ 9 1	11 32 P.M.	6 3 A.M.	12 34 P.M.
11.	10 47	+ 8 50	10 56	5 26	11 56 A.M.
21.	10 49	+ 8 46	10 17	4 47	11 17
31.	10 48	+ 8 50	9 38	4 8	10 38

Saturn.

1896.	R. A. H. M.	Declination. ° ′	Rises. H. M.	Transits. H. M.	Sets. H. M.
Dec. 1.	15 28	− 16 50	5 44 A.M.	10 45 A.M.	3 46 P.M.
11.	15 33	− 17 6	5 10	10 10	3 10
21.	15 37	− 17 21	4 35	9 35	2 35
31.	15 41	− 17 34	4 1	9 0	1 59

Uranus.

Dec. 1.	15 34	− 18 58	5 57 A.M.	10 50 A.M.	3 43 P.M.
11.	15 36	− 19 7	5 21	10 14	3 7
21.	15 39	− 19 14	4 45	9 37	2 29
31.	15 41	− 19 22	4 8	8 59	1 50

Neptune.

1896.	R. A. H. M.	Declination. ° ′	Rises. H. M.	Transits. H. M.	Sets. H. M.
Dec. 1.	5 14	+ 21 34	5 15 P.M.	12 32 A.M.	7 49 A.M.
11.	5 12	+ 21 33	4 30	11 47 P.M.	7 4
21.	5 11	+ 21 32	3 49	11 6	6 23
31.	5 10	+ 21 30	3 9	10 26	5 43

ECLIPSES OF *JUPITER'S* SATELLITES, P. S. T.

(Off left-hand limb, as seen in an inverting telescope.)

			H. M.				H. M.
IV, D,	Dec.	4.	12 12 A. M.	IV, D,	Dec.	20.	6 10 P. M.
IV, R,		4.	4 49 A. M.	IV, R,		20.	10 45 P. M.
II, D,		8.	12 5 A. M.	III, D,		23.	11 23 P. M.
I, D,		8.	2 7 A. M.	I, D,		24.	12 21 A. M.
I, D,		9.	8 35 P. M.	III, R,		24.	2 52 A. M.
II, D,		15.	2 41 A. M.	II, D,		25.	6 34 P. M.
I, D,		15.	4 0 A. M.	I, D,		31.	2 14 A. M.
III, D,		16.	7 25 P. M.	III, D,		31.	3 21 A. M.
III, R,		16.	10 55 P. M.	III, R,		31.	6 50 A. M.